

A Strategy for Nutrient-Enriched Waters in Virginia

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The quality of Virginia's surface waters, particularly those in the Chesapeake Bay drainage area, is being affected by the presence of excessive quantities of nutrients. In recognition of this, the Virginia Water Control Board has developed a strategy to protect the surface waters of the Commonwealth of Virginia from the effects of nutrient enrichment.

In the mid-1980s, the State's General Assembly formed a joint legislative subcommittee to study these problems in Chesapeake Bay. One of the recommendations in their final report was to direct the Virginia Water Control Board (VWCB) to develop water quality standards by July 1, 1988, to protect Chesapeake Bay and its tributaries from nutrient enrichment. The VWCB decided to expand this standards-setting activity statewide to include other river basins and lakes where there were known nutrient enrichment problems. A second legislative mandate to develop implementation strategies for carrying out these water quality standards was made jointly to the VWCB, which is responsible for point sources, and the Division of Soil and Water, which is responsible for nonpoint source controls. As a result, VWCB developed two regulations that became effective on May 25, 1988. The first established a water quality standard that designated as "nutrient-enriched waters" those waters of the Commonwealth that show evidence of degradation attributable to the presence of excessive nutrients. A companion policy regulation was created to control certain point source discharges of nutrients affecting State waters designated as "nutrient-enriched waters."

When developing the water quality standard, the VWCB was fortunate to have as background information not only joint State/EPA Chesapeake Bay Program studies but also a review prepared by the Washington Council of Governments on the types of water quality standards that other States were using to control nutrients. VWCB was also aware of the classification system for nutrient-sensitive waters that our neighboring State, North Carolina, had developed. As VWCB reviewed regulatory approaches to controlling nutrients, its lack of technical expertise on nutrient-related issues soon became apparent. To fill this need, they put together a Technical Advisory Committee comprised of 19 scientists from east coast universities and the Federal Government.

The VWCB used a variety of policy analysis techniques to obtain recommendations from the committee for the best indicators of nutrient enrichment. First, VWCB mailed a series of three delphi questionnaires to the scientists, asking them to identify major issues and reach some consensus on topics to focus on. The questionnaire responses were made anonymously to allow the scientists an opportunity to change their minds and not be biased by another individual on the committee. VWCB followed this process with a two-day spring workshop run in Williamsburg by the University of Virginia's Institute of Environmental Negotiation, which compiled a summary report.

The Technical Advisory Committee recommended four parameters that could be used as in-stream indicators of nutrient enrichment. Listed in descending order of importance they are: chlorophyll a,

dissolved oxygen fluctuations, total phosphorus, and total nitrogen. Note that the first two parameters are symptoms of over-enrichment rather than direct measurements of nutrients.

Taking into consideration the recommendation of the committee, VWCB decided to base its designations on the first three parameters. A reference to these parameters was included in the introduction to the water quality standard regulation for designating nutrient enriched waters. VWCB was intentionally silent on the numeric limits, as the committee had advised, because unacceptable amounts of these parameters could vary depending on the type of waterbody, whether it were a lake, free-flowing river, or tidal estuary. Since every designation would involve an amendment to Virginia's water quality standards, and since full public participation is required by the agency and State rules for adopting regulations, VWCB felt that the public would be properly notified in every case of the appropriate scientific and numeric basis for these designations.

Average seasonal concentrations of chlorophyll a exceeding 25 : g/L, dissolved oxygen fluctuations, and high water column concentrations of total phosphorus were the indicators used to evaluate the historical data and to identify those waters affected by excessive nutrients. Chlorophyll a, a pigment found in all plants, was used as the primary indicator because it indicates the quantity of plant growth. With the exception of the mainstem of the Chesapeake Bay, the waterbodies designated as "nutrient enriched" had a historical record of chlorophyll a measurements in the visible range-sufficient to discolor the water. The Virginia portion of the Chesapeake Bay mainstem was included because slight to moderate enrichment was becoming evident and because it is part of the whole Chesapeake Bay, which is a nutrient-enriched system. Management programs are needed to prevent further degradation of this valuable resource.

Based on a review of historical water quality records, the board designated as "nutrient enriched waters" three lakes, one tributary to a lake, nine embayments or tributaries to the Potomac River, the Virginia portion of the Chesapeake Bay, and a large portion of the Bay's tributaries. Since this initial round of designations, VWCB has amended the standard once to designate the tidal freshwater portion of the Chowan River Basin in Virginia. VWCB intends to continue to review these designations and, during the triennial review of water quality standards, will consider additions and deletions to the list. Presently VWCB is initiating field studies of a freshwater river and a lake that may be designated "nutrient enriched" during the 1990 triennial review.

Since VWCB has authority to issue National Pollution Discharge Elimination System (NPDES) permits and thereby control point source discharges of nutrients a policy for controlling certain point sources of nutrients to those waters designated as "nutrient enriched" was established. (Another agency, the Division of Soil and Water, has developed strategies for managing nonpoint sources of nutrients to "nutrient enriched waters.") The policy requires certain municipal and industrial organizations that discharge effluents containing phosphorus to maintain a monthly average total phosphorus concentration of 2 mg/L or less. The 2 mg/L limit proposed is based upon the following criteria: limits that are readily achievable by chemical addition processes as demonstrated by experiences in other parts of the country and suggested achievable limits for biological phosphorus removal contained in several reports as well as in State pilot plant studies. VWCB has found that this level of phosphorus removal allows it to meet the 40 percent reduction goal for point source total phosphorus for Virginia's portion of Chesapeake Bay.

Municipal and industrial dischargers that release phosphorus in concentrations above 2 mg/L to these "nutrient-enriched waters" are subject to this policy if they have a design flow of 1.0 MGD or greater and a permit issued on or before July 1, 1988. These dischargers are required to meet the 2 mg/L

effluent limitation as quickly as possible and, In any event, within three years following modification of the NPDES permit. If the discharger voluntarily accepts a permit to require installation and operation of nitrogen removal facilities to meet a monthly average total nitrogen effluent limitation of 10 mg/L for April through October, the discharger will be allowed an additional year to meet the phosphorus effluent limitation.

All new source dischargers with a permit issued after July 1, 1988, and a design flow greater than or equal to 0.05 MGD that propose to discharge to "nutrient-enriched waters" will also be required to meet a monthly average total phosphorus effluent limitation of 2 mg/L. All dischargers to "nutrient-enriched waters" that, at the time of that designation were subject to effluent limitations more stringent than the 2 mg/L monthly average total phosphorus, are required to continue to meet the more stringent phosphorus limitation.

The initial regulations impacted 20 municipal and 5 industrial dischargers. An additional 10 were already meeting more stringent total phosphorus standards. One additional discharger was affected when this water quality standard was amended to add the tidal freshwater portion of the Chowan River to the list of "nutrient-enriched waters."

The estimated cost to the regulated community of the original regulations ranged from \$27.5 million to \$228 million, depending on the type of phosphorus removal technology selected. Costs of phosphorus removal were estimated for three treatment technologies. The least expensive alternative, biological phosphorus removal, was estimated to cost \$16.51 million, plus an additional \$6.75 million to \$11 million for royalty fees. Chemical addition with simultaneous precipitation was estimated to cost about \$88.86 million. The most expensive of the alternatives explored, chemical addition with post-precipitation, was estimated to cost about \$228 million.

The policy regulation also contains language that allows VWCB to require monitoring of discharges when the permittee has the potential for discharging monthly average total phosphorus greater than 2 mg/L and also allows adjoining States to petition the Board to consider rule makings to control nutrients entering tributaries to their nutrient-enriched waters.

The policy regulation states that after the point source controls are implemented and the effects of this policy and the nonpoint source control programs are evaluated, VWCB should recognize that it may be necessary to impose further limitations on dischargers of nutrients to control undesirable growths of aquatic plants. This policy can thus be viewed as the first phase of a strategy to protect Virginia's waters from the effects of nutrient enrichment.